REMARKS

This reply encompasses a bona fide attempt to overcome the objections and rejections raised by the Examiner and to move the application forward to an allowance. Amendments to the specification are made to make some implicit statements explicit. No new matter was added by these amendments.

Drawings

1. The drawings are objected to under 37 CFR 1.83(a).

In reply, the Applicants have canceled claims **13-14, 32-33** and amended claim **20**. Accordingly the Applicants kindly request the objection related to the drawings to be withdrawn.

Claim Rejections – 35 USC 102

1. The Examiner rejects claims **1-7, 12-26** and **31-38** under 35 USC 102(b) as being anticipated by Albrecht (US Patent No. 4,411,711).

In reply, the Applicants respectfully submit amended claims **1, 20** to distinctly claim over the prior art of record.

IN CONCLUSION

To move the application forward to an allowance the Applicants have amended claims **1, 20** and believe that claims **1, 20** are novel and unobvious over the prior art of record. Accordingly, allowance of the claims now in the application is kindly requested.

Respectfully submitted,

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AMENDMENT TO THE SPECIFICATION

Please amend the paragraph starting with "The actuator elements ... " on page 9, line 10 accordingly:

The actuator elements of the present invention can be positioned in any type of shape. For instance, as shown in **FIG. 3**, actuator element **110** in the first phase can be any type of curved shape. However, the actuator element can also be any type of non-linear shape or any type of irregular shape as long as a strain gradient can be established. **FIG. 3** shows a rotary action or movement of actuator element **110**. Although, the example in **FIG. 3** shows a linear position in the second phase, the second phase does not have to be perfectly linear, it could also be substantially linear or less curved compared to the first phase as long as it is in the direction to minimize the strain gradient.

In addition to the examples described *supra*, initially holding a linear shape memory element in a non-linear shape with an initial strain gradient imposed around the neutral axis of the element, enables overall strain gradient to be maximized in the first phase, and maximized force is exerted in a pre-determined direction during phase transformation. When activating the actuator, increased stiffness in the second phase moves the actuator in a pre-determined direction, thereby minimizing the initial strain gradient. Thus, using the same straight/linear element **110**, different types of motion and output force can be designed depending on how the strain gradient is formed initially. Unlike the linear starting shape for the first phase as shown in **Fig. 3**, **FIG. 4** shows actuator element **110** that is held in ~~with~~ a non-linear shape **410** in the first phase before activation by activation means. In this initial shape, overall strain gradient is maximized in the first phase **410**. Once actuator element **110** has been activated and a transition in actuator element **110** has occurred to minimize the strain gradient and maximize the output force in the second

phase~~, the resulting second phase can also be any type of shape as shown by **420** as long as it is different compared to **410**~~. In this case, shape **420** is the shape with minimized strain gradient after activation.~~a different non-linear shape~~. Furthermore, **FIG. 4** shows a ~~linear action~~ push movement **430** that ~~can generate a push motion 430~~ is generated by actuator element **110** to minimize the strain gradient.

Please amend the paragraph starting with "**FIG. 5** … " on page 9, line 25 and continuing on page 10 accordingly:

FIG. 5 shows actuator element **110** with ~~different~~ another non-linear shape **510** in the first phase before activation by activation means. Once actuator element **110** has been activated and a transition in the actuator element has occurred to minimize the strain gradient and maximize the output force in the second phase. In this case, the resulting second phase ~~can also be any type of shape as shown by 520 as long as it minimizes the strain gradient~~ makes shape **520** with minimized strain gradient after activation. In this case, shape **520** is again a different non-linear shape compared to **510**. Furthermore, **FIG. 5** shows a ~~linear action~~ pulling movement **530** that ~~can generate a pull motion~~ is generated ~~**530**~~ by actuator element **110** to minimize the strain gradient. Compared to conventional other actuators that are purely based on shape memory effect, the present invention provides a way to control/manipulate output movement and force of the SMA actuators independent of originally fabricated or memorized shape (e.g. linear or circular shape). ~~In addition, **FIG. 5** shows an expanding (rotary) action or movement by actuator element **110** as indicated by **540**. In this particular example of **FIG. 5**, a combined linear **530** and rotary or expanding **540** movement or action can be achieved.~~ As one skilled in the art might readily appreciate, the actuator element can be positioned in various different shapes or configurations and can generate different types of linear, rotary, expanding movements or actions. The present invention is not limited to any combination of these different movements or actions such as a combined linear and rotary movement. Furthermore, the linear actions generated from strain gradient variation can be combined with contraction motion and implemented to produce stronger force with larger deflection.

AMENDMENT TO THE CLAIMS:

Claim 1 (*currently amended*) An actuator to control motion and force, comprising: ~~an actuator element with a strain gradient variation between a first phase and a second phase~~

an actuator element comprising a shape memory alloy, said actuator element being held in a first position other than a linear position, wherein said linear position is characterized as the originally memorized or fabricated position, to impose an initial strain gradient around the neutral axis of said actuator element,

said actuator element having a second position different from said first position wherein said second position having an increase in said initial strain gradient,

whereby a change between said second position and said first position moves said second position of said actuator element toward said first position of said actuator element therewith minimizing the strain gradient between said second position and said first position back to said initial strain gradient, said change providing a controlled means for motion and force independent of said originally memorized or fabricated shape.

Claim 2-19 (Canceled)

Claim 20 (*currently amended*) A method for controlling motion and force, comprising: ~~of providing an actuator, comprising the steps of:~~

~~(a) providing an actuator element;~~

~~(b) providing a strain gradient variation between a first phase and a second phase of said actuator element; and~~

~~(c) providing an activating means to activate said actuator element and transition said actuator element from said first phase to said second phase.~~

(a) providing an actuator element comprising a shape memory alloy;

(b) holding said actuator element in a first position other than a linear position, wherein said linear position is characterized as the originally memorized or fabricated position, to impose an initial strain gradient around the neutral axis of said actuator element;

(c) having said actuator element in a second position different from said first position wherein said second position having an increase in said initial strain gradient; and

(d) changing between said second position and said first position by moving said second position of said actuator element toward said first position of said actuator element therewith minimizing the strain gradient between said second position and said first position back to said initial strain gradient, said change providing a controlled means for motion and force independent of said originally memorized or fabricated shape.

Claim 21-48 (Canceled)